Object-oriented programming and data-structures

CS/ENGRD 2110
SUMMER 2018
Lecture 1 Outline

- Languages Overview
  - Imperative vs Declarative.
- Types
- Variable Assignment
- Control Flow and Procedures
  - scoping
Languages

- Declarative vs Imperative languages
  - Declarative:
    - Specify what should be done, not how
    - Ex: SQL `select * from people where name = "Natacha"`
  - Imperative
    - Specify both how and what should be done

- Java is **imperative** and **procedural**. What about Python?
Types

- Definition: **A type is a set of values together with operations on them**

- Java defines **primitive types** and **reference types**
  - Primitive types: Built-in types that act as building blocks for more complicated types that we’ll look at next lecture
  - Reference types: Next lecture :)

- Example Type: **integer**:
  - values: ..., –3, –2, –1, 0, 1, 2, 3, ...
  - operations: +, –, *, /, unary –

- What about type **boolean**?
## Most-used ‘primitive’ types

<table>
<thead>
<tr>
<th>Type</th>
<th>Values</th>
<th>Operations</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>int</code></td>
<td>(-2^{31} \ldots 2^{31}-1)</td>
<td>+, -, *, /, %, unary –</td>
<td>32 bits as signed integer</td>
</tr>
<tr>
<td><code>double</code></td>
<td>values like: (-22.51E6, 24.9)</td>
<td>+, -, *, /, %, unary –</td>
<td>64 bits as floating point number</td>
</tr>
</tbody>
</table>
| `char` | values like: 'V', '$', '
'   | none                      | 16 bits                   |
| `boolean` | values: true, false | ! (not), && (and), || (or) | 1 bit                     |
Strong Typing

Matlab and Python are **weakly typed**: One variable can contain at different times a number, a string, an array, etc. One isn’t so concerned with types.

Java **strongly typed**: A variable must be declared before it is used and can contain only values of the type with which it is declared.
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Valid Python sequence:

```
x= 100;
x= 'Hello World';
x= (1, 2, 3, 4, 5);
```
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Valid Python sequence:

- `x = 100;`
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Corresponding Java

```java
int x;
```

```java
x = 100;
```

```java
x = "Hello";
```

Illegal assignment:

“Hello” is not an `int`

Declaration of `x`:
`x` can contain only values of type `int`
The reason for all of this may not seem clear right now, will become clearer in next couple of lectures

```java
package packageName;

class myClass{
    void proc() {...}
    int fun() {...}
    public static void main(String[] args) { fun(); proc(); ... }
}
```

Must place myClass in file myClass.java
Basic variable declaration

**Declaration**: gives name of variable, type of value it can contain

```plaintext
int x;
\text{Declaration of } x, \text{ can contain an int value}

double area;
\text{Declaration of } area, \text{ can contain a double value}

int[] a;
\text{Declaration of } a, \text{ an int array.}
```
Assignment statement

**Assignment**: assigns value to a variable.

Much like in other languages — need ‘;’ at end:

```
<variable> = <expression> ;
```
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Much like in other languages — need ‘;’ at end:

```
<variable> = <expression> ;
```

```plaintext
int x;
x = 10;
... other code
x = x + 1;
```

Have to declare `x` before assigning to it.

```plaintext
int x = 10;
... other code
x = x + 1;
```

Can combine declaration with an initializing assignment. Shorthand for a declaration followed by an assignment.
Weakly typed versus strongly typed

x = 75 + "Hello";
int x = 75 + "Hello";

myVar = 100;
myVar = myvar + 1
print myVar

int myVar = 100;
myVar = myvar + 1;
System.out.println(myVar);

What happens in Python?
What happens in Java?

What happens in Python?
What happens in Java?
Weakly typed versus strongly typed

Weakly typed:

Shorter programs, generally.

Programmer has more freedom, language is more liberal in applying operations to values.

Strongly typed:

Programmer has to be more disciplined. Declarations provide a place for comments about variables.

More errors caught at compile-time (e.g. it’s a syntax error to assign a string to an `int` variable).

Note: weak and strong typing not well defined; literature has several definitions
Functions & Procedures.

- Group linked actions into a single unit of execution
  - **Functions** take input **parameters** and return **something**
  - ** Procedures** take input **parameters** and return **nothing**
Functions & Procedures.

- Group linked actions into a single unit of execution
- Functions take input parameters and return something
- Procedures take input parameters and return nothing

```java
/** return sum of a and b */
public double sumFunction(double a, double b) {
    System.out.println("Sum of "+a+" and "+ b);
    return a + b;
}

/** prints sum of a and b */
public void sumProcedure(double a, double b) {
    System.out.println("Sum is "+ (a + b));
}
```
Control Flow Recap

- Control flow syntax is similar to other languages
  - For (initialisation; termination; increment)
    - For (int i = 0 ; i < 10 ; i++) { … }
  - While(boolean_expression)
    - While (i < 10) { … ; i++}
  - If (boolean_exp)
    - If { … } else { … }

- Branching statements
  - Break: Exit loop
  - Continue: Skip concurrent iteration of loop
  - Return: Exit function immediately
Local Variables

- **Definition:** defined inside a function/procedure or in any conditional block. They have **block-level scope** and are only accessible in the block where they are defined.
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```java
/** return sum of a and b */
public double sumFunction(double a, double b) {
    double sum = a + b;
    System.out.println("Sum of " + a + " and " + b);
    return sum;
}
```

- Use local variables to write clean code and avoid repetition!
Local Variables - Scoping

- **Definition**: defined inside a function/procedure or in any conditional block. They have **block-level scope** and are only accessible in the block where they are defined.

- A block is defined by a starting bracket `{ and a closing bracket }`

- Local variables are destroyed once they go outside of scope
Local Variables - Shadowing

- **Definition**: A variable *shadows* another if they have the same name and are accessible in the same place.

- To what declaration does a name refer?
  - Code in a block can reference names declared in that block, as well as names that appear in enclosing blocks.

- **Use inside-out rule**: Look first in method body, starting from name and moving out; then look at parameters; then look outside method in the object.
Local Variables - Shadowing

double sum = 0.0;
/** return sum of a and b */
double sumFunction(double a, double b) {
    if (a>0.0) {
        double sum = a + b;
        System.out.println("Sum is " + sum);
    }
    System.out.println("Sum is " + sum);
    return sum;
}

Always give clear names to your variables
Create variables with the smallest possible scopes. As close to their first use

What will the print statements output?
References in JavaHyperText

type
primitive type
type, strong versus weak typing
function
function call
procedure
procedure call
variable
variable declaration
expression
assignment statement
local variables